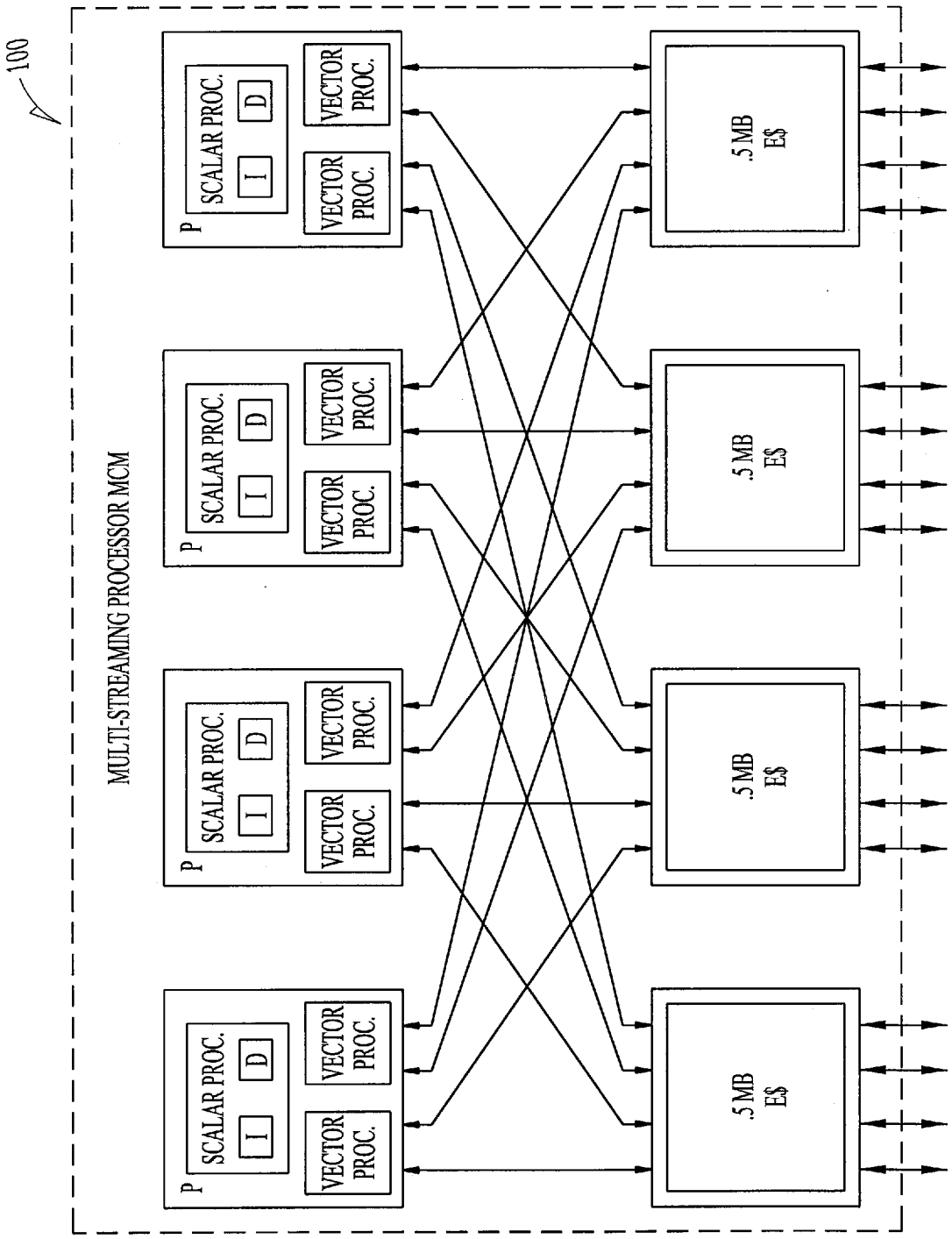
100
MULTI-STREAMING PROCESSOR MCM
P
SCALAR PROC.
I
D
VECTOR PROC.
VECTOR PROC.
VECTOR PROC.
VECTOR PROC.
.5 MB E$
.5 MB E$
.5 MB E$
.5 MB E$

FIG. 1A

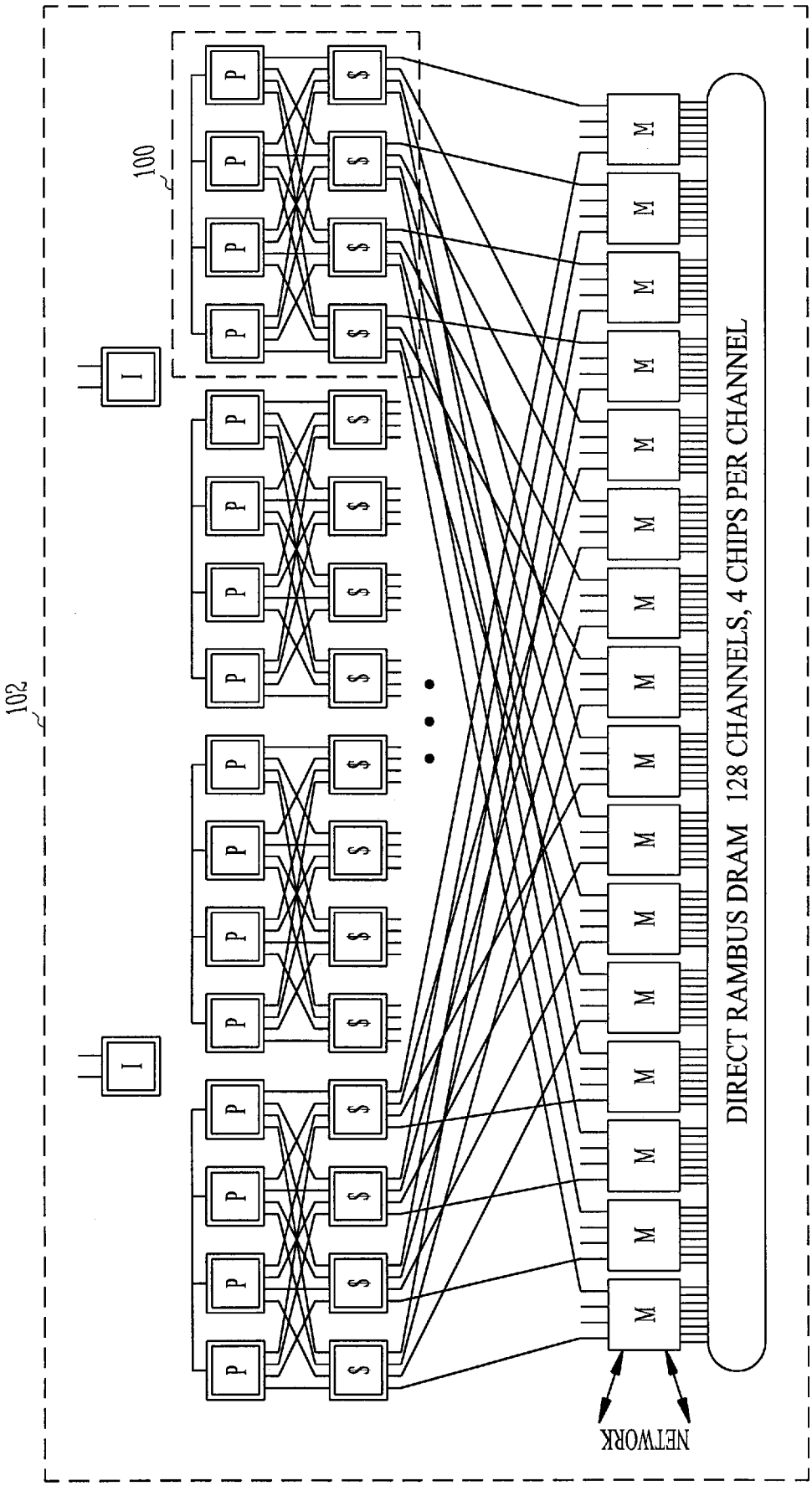
102
100
P
$
I
M
DIRECT RAMBUS DRAM 128 CHANNELS, 4 CHIPS PER CHANNEL
NETWORK

FIG. 1B

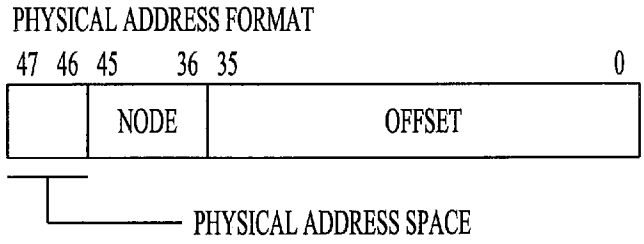

FIG. 2A

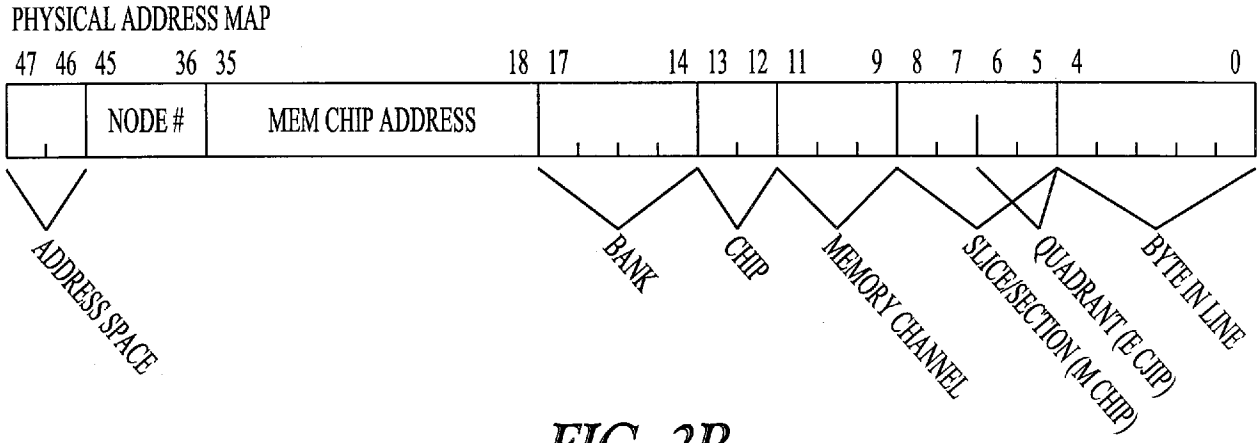

FIG. 2B

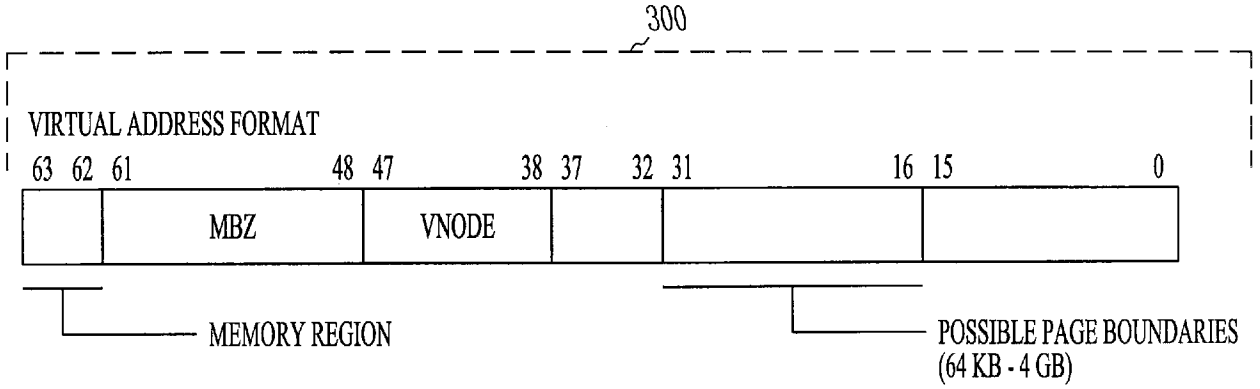

FIG. 3

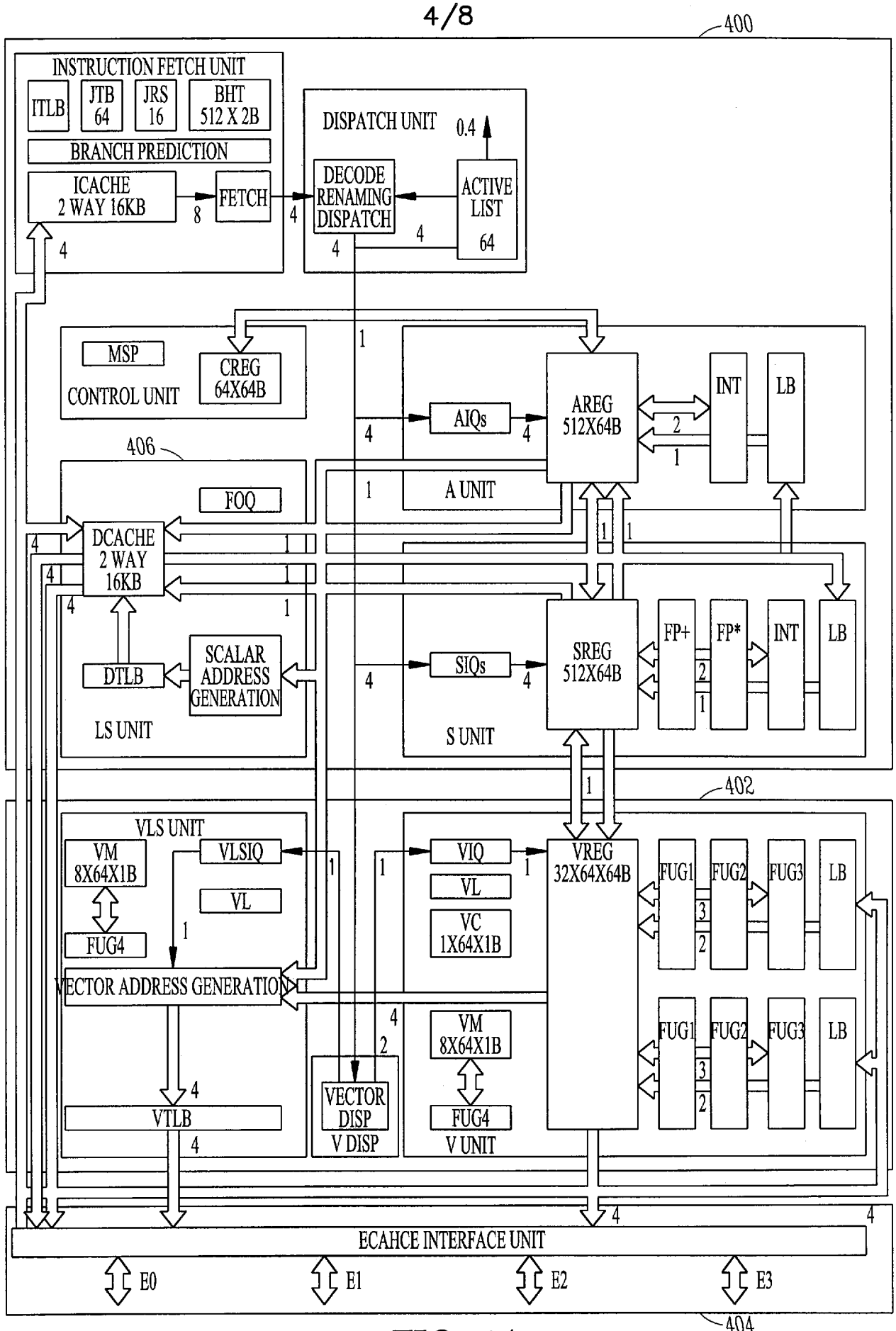
400
INSTRUCTION FETCH UNIT
ITLB
JTB 64
JRS 16
BHT 512 X 2B
BRANCH PREDICTION
ICACHE 2 WAY 16KB
FETCH
DISPATCH UNIT
0.4
DECODE RENAMING DISPATCH
ACTIVE LIST 64
MSP
CONTROL UNIT
CREG 64X64B
AIQs
AREG 512X64B
INT
LB
406
FOQ
A UNIT
DCACHE 2 WAY 16KB
DTLB
SCALAR ADDRESS GENERATION
LS UNIT
SIQs
SREG 512X64B
FP+
FP*
INT
LB
S UNIT
402
VLS UNIT
VM 8X64X1B
VLSIQ
VL
FUG4
VECTOR ADDRESS GENERATION
VTLB
VIQ
VL
VC 1X64X1B
VREG 32X64X64B
FUG1
FUG2
FUG3
LB
VM 8X64X1B
FUG4
V UNIT
VECTOR DISP
V DISP
ECAHCE INTERFACE UNIT
E0
E1
E2
E3
404

FIG. 4A

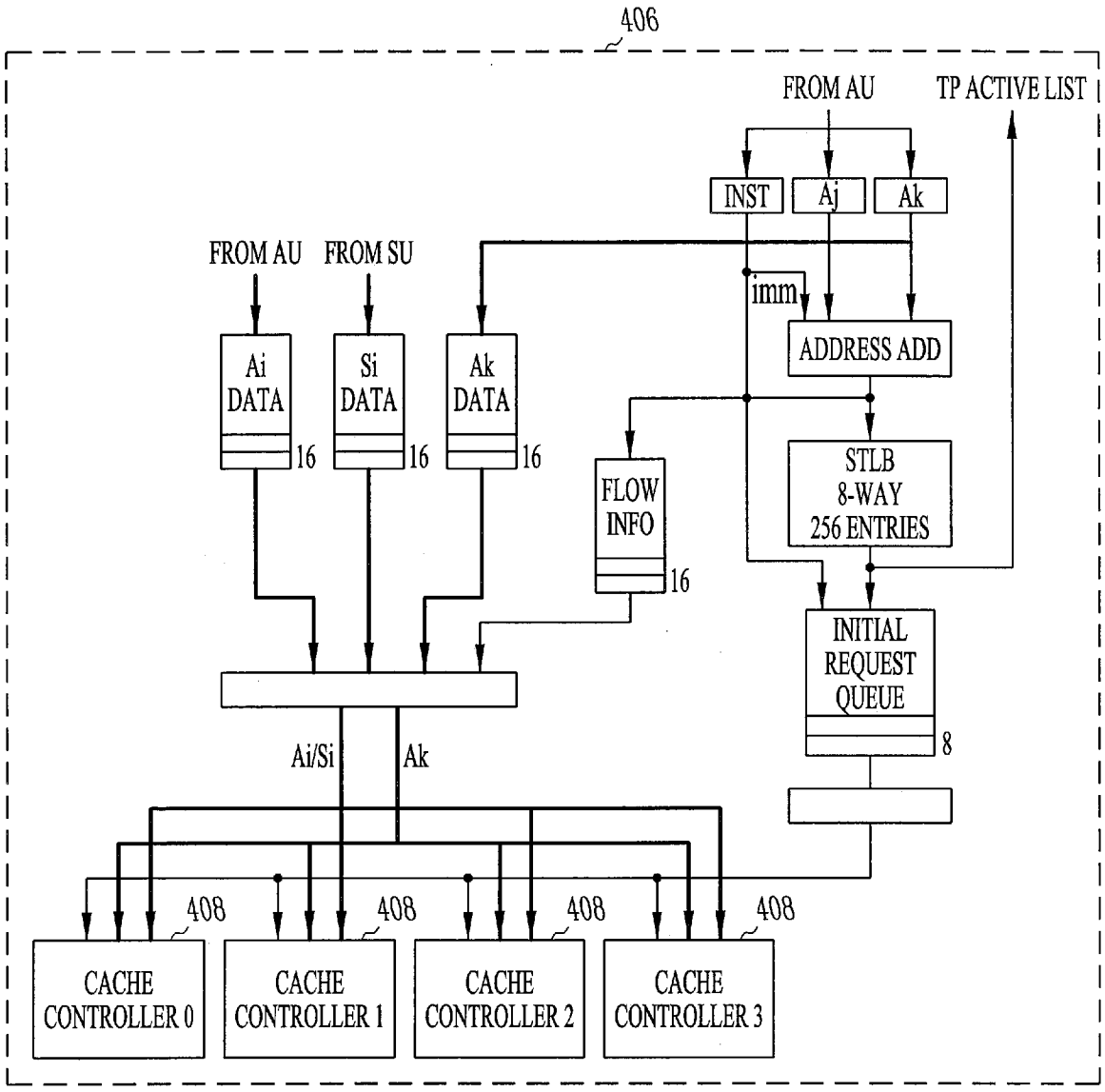
406
FROM AU
TP ACTIVE LIST
INST
Aj
Ak
FROM AU
FROM SU
imm
ADDRESS ADD
Ai DATA
Si DATA
Ak DATA
16
16
16
FLOW INFO
16
STLB 8-WAY 256 ENTRIES
INITIAL REQUEST QUEUE
8
Ai/Si
Ak
408
408
408
408
CACHE CONTROLLER 0
CACHE CONTROLLER 1
CACHE CONTROLLER 2
CACHE CONTROLLER 3

FIG. 4B

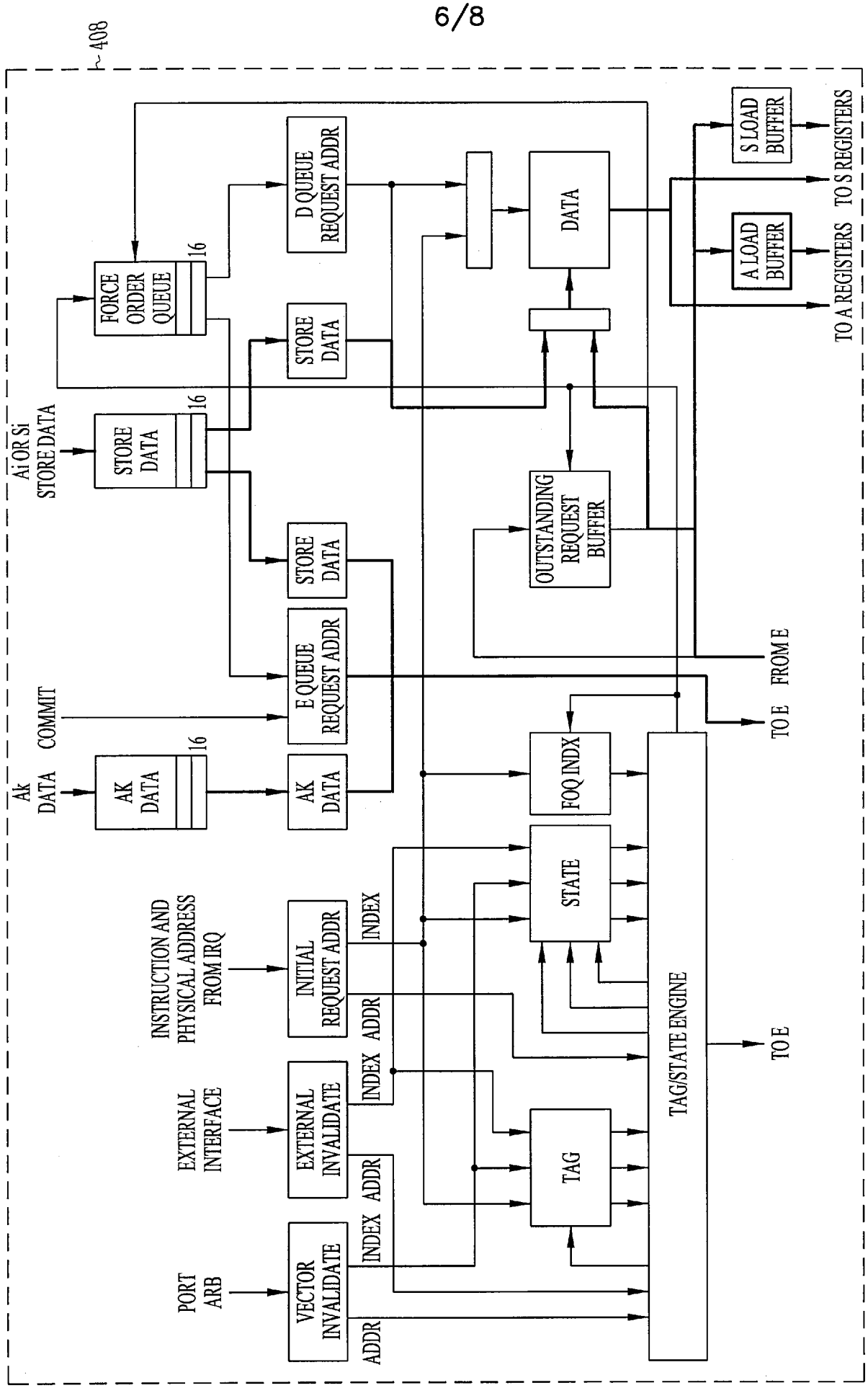
408
FORCE ORDER QUEUE
16
D QUEUE REQUEST ADDR
DATA
S LOAD BUFFER
TO S REGISTERS
A LOAD BUFFER
TO A REGISTERS
STORE DATA
Ai OR Si STORE DATA
16
STORE DATA
OUTSTANDING REQUEST BUFFER
STORE DATA
E QUEUE REQUEST ADDR
FROM E
TO E
Ak COMMIT
Ak DATA
16
AK DATA
AK DATA
FOQ INDX
STATE
INSTRUCTION AND PHYSICAL ADDRESS FROM IRQ
INITIAL REQUEST ADDR
INDEX
ADDR
EXTERNAL INTERFACE
EXTERNAL INVALIDATE
INDEX
ADDR
TAG
TAG/STATE ENGINE
TO E
PORT ARB
VECTOR INVALIDATE
INDEX
ADDR

FIG. 4C

410

DCACHE BYPASS	INITIAL REQUEST	TAG & STATE	FOQ INDEX MATCH	ACTION								
				MSG TO E	D$	FOQ ENTRY	E	D	P	ALLOCATE	ORB ENTRY	OTHER
NO	Read	MISS	NO	Read		Dummy		X	X	LRU Way	Read	
			YES			ReadUC	X				Read nc†	
		HIT	NO		Read							
			YES ‡			Read		X				
	ReadShared	MISS	NO	ReadShared		Dummy		X	X	LRU Way	Read	
			YES			ReadUC-Shared	X				Read nc	
		HIT	NO		Read							
			YES ++			Read		X				
	ReadNA	MISS	NO	ReadNA							Read	
			YES			ReadNA	X				Read nc	
		HIT	NO		Read							
			YES			Read		X				
	Write	MISS	NO	ReadMod		SWrite	X	X	X	LRU Way	Read	
			YES			SWrite	X					
		HIT	NO			SWrite	X	X				
			YES									
	WriteNA	MISS	NO			SWriteNA	X					
			YES									
		HIT	NO			SWrite	X	X				
			YES									
	Prefetch (to discard)	MISS	NO									
			YES									Discard
		HIT	NO									
			YES									

FIG. 4D

410

DCACHE BYPASS	INITIAL REQUEST	TAG & STATE	FOQ INDEX MATCH	ACTION: MSG TO E	D$	FOQ ENTRY	E	D	P	ALLOCATE	ORB ENTRY	OTHER
YES	Read	MISS	NO			ReadUC	X				Read nc	
			YES									
		HIT	NO							Invalidate		
			YES									
	ReadShared	MISS	NO			ReadUC-Shared	X				Read nc	
			YES									
		HIT	NO							Invalidate		
			YES									
	ReadNA	MISS	NO			ReadNA	X				Read nc	
			YES									
		HIT	NO							Invalidate		
			YES									
	Write	MISS	NO			SWrite	X					
			YES									
		HIT	NO					X				
			YES									
	WriteNA	MISS	NO			SWriteNA	X					
			YES									
		HIT	NO					X				
			YES									
	Prefetch (to discard)	MISS	NO									Discard
			YES									
		HIT	NO									
			YES									
	IORead					ReadNA to IO space	X				Read nc	
	IOWrite					SWriteNA to IO space	X					
	afadd ‡‡					afadd (1 dw)	X				Read nc	
	afax					afax (2 dw)	X				Read nc	
	acswap					acswap (2 dw)	X				Read nc	
	aadd					aadd (1 dw)	X					
	aax					aax (2 dw)	X					
	Lsync_s_v					Lsync_s_v	X					
	Lsync_v_s					Lsync_v_s	X					Hold IRQ
	Msync					Msync	X					Bypass Mode On
	Msync P Msync V					Msync	X					
	Gsync					Gsync	X					

† A "Read nc" ORB entry specifies that the returning data will not be cached. Both ReadNA and ReadUC requests use "Read nc" ORB entries. (A ReadNA tells the Ecache not to allocate the line. A ReadUC tells the Ecache that the P CHIP will not be caching the line but the Ecache still should.)

‡ Do more sophisticated match here (require pending or word match) †† Do more sophisticated match here (require pending or word match)

‡‡ These five packet types are AMOs. The FOQ column indicates how many dwords of adat accompany the request. Three of the AMOs return data, and two do not.

FIG. 4E